A homebrewers guide to UPCYCLE UNWANTED BREAD IN TO BEER

"29 MILLION LOAVES OF BREAD ARE WASTED ANNUALLY IN NEW ZEALAND"

'Upcycling' some of the 29 million loaves of bread wasted annually in New Zealand *(1) into beer, is a fun concept that can help to raise awareness of food waste and divert unused bread away from landfills. Working with Citizen Collective*(2) Food Scientists at the University of Otago set out to explore the maximum amount of bread that could be substituted into a good tasting beer by developing a unique mashing regime. Based on a series of product development trials, a winning recipe which substitutes 50% of the malt with bread has been developed. By optimising the mash regime, we increased the amount of bread in upcycled beer from 25% to 75% of the carbohydrates required. Using this recipe, 4.75 slices of bread are used per 500ml of beer. The team are delighted to share this with you now, all in the name of waste reduction and good beer brewing! This infographic provides step-by-step instructions on how you can become a food waste conscious brewer. From a simple 'how-to-guide' through to a section on 'Extra for Experts', this resource guide contains everything you need to know about brewing beer from bread. So, we challenge you now to attempt brewing your own beer using any leftover bread you can find and in doing so join the movement in reducing the number of loaves going to waste whilst contributing to the overall global food waste problem! We are confident this winnable solution will lead to nothing but hoppiness!

Happy brewing!

The Upcycled Food Lab *(3), University of Otago

WHAT YOU'LL NEED:

FOR THE MASH

- 1900g unwanted bread
- 1300g NZ pilsner malt
- 9.1L water + 2L sparge water

FOR THE BOIL

- 20g Rakau hops (9.5% alpha acids
- 16g Riwaka hops (4% alpha acids)
- 1.2L water

TO FERMENT

- 1L water
- 14g 34/74 SafaleLager yeast
- 60g sugar

BEER STYLE: KIWI PILSNER | ORIGINAL GRAVITY: 1.053 | YIELD: 10L

1. PREPARE THE BREAD

1. Using a food processor grind the bread into a consistent, small crumb (this can be done in small batches with a regular kitchen processor).
2. In the same manner, mill the malt in the food processor to achieve a crushed grain ensuring the kernels break apart.

SEE EXTRA FOR EXPERTS: TIP 1

"The bread used for this recipe was Nature's Fresh white sandwich bread, to ensure experimental consistency, which contained 2.73% salt per loaf. Higher percentages of bread substituted for malt can lead to salty beer, which can be desirable if you wish to make a salty beer e.g., an oyster stout. Try to use low salt bread if possible, to avoid saltiness"

2. STEP MASH

1. Add the bread and malt to a 20L plastic bucket. Mix well and place the bucket in a large container of water at 45°C (a chilly bin is good as it holds heat well).
2. Mash in by adding to the bucket containing the bread and malt 9.1L strike water (~ 55°C) to hit a mash temp of 45°C and hold for an hour. Monitor the temp and add more hot water to the water bath (chilly bin) if needed.
3. Add boiling water to the water in your water bath to raise the mash temp to 60°C. Hold at 60°C for 20 minutes. Monitor the temp and add more hot water if needed.
4. Increase the mash temp to 65 °C. Hold for 30 minutes, monitor and adjust the temp as required.
5. Finally, increase the mash temp to 70°CHold for hold for an hour, monitor and adjust the temp as required.

SEE EXTRA FOR EXPERTS: TIP 2

"The goal of the typical mashing process is for enzymes in the malt to break down the starch in the grain and the bread to fermentable sugars. This creates the sweet fermentable liquid called sweet wort"

3. SPARGE AND FILTER

"Due to the bread's composition, small particles end up in the wort. Filtering the wort as it drains catches most of those small particles, retaining a cleaner wort"

1. Filter the contents of the mash to obtain the sweet wort. It will be best to put it through progressively finer sieves and finally several layers of muslin cloth. You should retain ~7L.
2. Sparge the mash with 2L of hot water (~80°C).
3. Pour the remaining grain through a sieve using a spoon to move the grain around to squeeze out the liquid.
4. Discard the leftovers and repeat until all the grain has been drained.
5. Transfer the extracted wort into a large pot for boiling.

SEE EXTRA FOR EXPERTS: TIP 3

4. BOIL AND ADD HOPS

"Hops are the flowers or cones of a plant called Humulus Lupulus. The hops are a key component of the beer's aroma, flavour and bitterness. Hops are divided into two very general varieties: bittering and aroma. Bittering hops will have higher alpha acids. Aroma hops will tend to have more essential oils."

1. Add 1.2L boiling water to the boiling pot to allow for water loss during the boil.
2. Add the Rakau hops, then boil the wort for 30 minutes (a nice rolling boil).
3. After boiling for 30 minutes, add the Riwaka hops, turn off heat, put on the lid on the and let sit for 10 minutes.

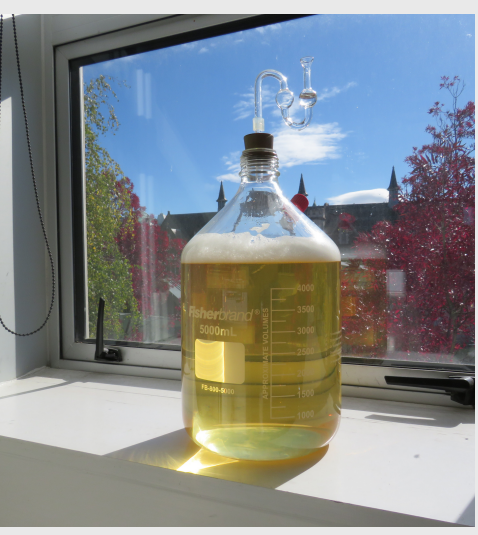
5. COLD BREAK

"Chilling the wort quickly will help the protein in the wort clump together and fall out of solution. Brewers call this the "cold break". Removing protein at this step helps to achieve a clearer, better looking brew"

1. Prepare sterile vessels for the cold break using Star San or a similar product.
2. Add 1L of boiling water to the bitter wort.
3. Transfer the bitter wort into the vessels.
4. Place in the fridge over night to let the clear wort separate or until the solids and liquid have visibility separated.

6. FERMENT

"The yeast strain used is arguably the most important contributor to beer flavour. Brewers must consider 5 factors when selecting yeast strains; attenuation, flocculation, alcohol tolerance, temperature range and sensory profile."



1. Sterilise the fermentation vessel using Star San or a similar product.
2. Carefully pour the clear wort from the fridge to the fermenting vessel, leaving behind the solid material (trub). Alternatively, you can siphon out the clear wort.
3. Pitch 14g of yeast 10L of wort.
4. Leave to ferment at 15°C for 5 days.
5. Monitor the specific gravity and end of ferment.
6. Carefully pour/siphon the beer into sterile bottles.
7. Add 6g of sugar per litre of beer and seal the bottles.
8. Leave in a cool, dark place for two weeks.
9. Crack open and enjoy.

SEE EXTRA FOR EXPERTS: TIP 4

GIVE SPENT GRAIN NEW LIFE

In the US 27 billion kilograms of spent grain is generated every year! Spent grain is the leftovers from brewing. There are ample opportunities to upcycle this valuable 'waste' stream. A number of entrepreneurs have built their business on the growing interest of spent grain, for example Regrained *(4) take spent grain and upcycle it into flour and Rutherford and Meyer, The Upcycled Grain Project *(5) produce spent grain crackers. You can find many more innovative businesses upcycling food on the Upcycled Food Association *(6) website. You can be an entrepreneur in your own home using spent grain from your homebrewing process. The University of Otago would like to offer an upcycled solution for your spent grain, a vegan spent grain chocolate cake with chocolate beer icing.

Find the recipe on our website https://foodwaste-otago.org/news/the-star-cake-and-beer-together-at-last

*(1) Love Food Hate Waste. https://lovefoodhatewaste.co.nz/food-waste/what-we-waste/
*(2) Citizen Collective - a collective of chefs, brewers, bakers and innovators who want to reduce food and resource waste. This group is commercially producing beer made with 25% bread see https://citizen.co.nz
*(3) The Upcycled Food Lab. https://foodwaste-otago.org/
*(4) Regrained. https://www.regrained.com/
*(5) Rutherford and Meyer. Upcycled Grain Project. https://rutherfordandmeyer.co.nz/collections/upcycled-grain-project
*(6) The Upcycled Food Association. https://www.upcycledfood.org/

EQUIPMENT YOU WILL NEED

EQUIPMENT LIST:

- mill or coffee grinder
- food processor
- 20L mashing tun (food-grade plastic bucket)
- water bath (chilly bin)
- 20L boil kettle or stainless-steel pot
- measuring cup
- stirring spoon
- carboy or food-grade plastic bucket with an airlock lid
- strainer/sieve
- funnel
- food-grade tubing
- filter or muslin cloth/coffee filter
- scales
- thermometer
- no- rinse steriliser (Star San)
- bottles
- bottle capper

If you are new to the brewing game or need to buy some new supplies, websites like: https://www.brewshop.co.nz/ are a one-stop shop to help you get sorted with the resources you need. If you are attempting brewing for your first time, it may be useful to purchase a starter kit.

EXTRA FOR EXPERTS:

This next section is for those that are seeking a little deeper understanding into the bread-beer brewing process. Understanding the process in a more precise way will help you to brew better more consistent beer. In relation to brewing beer with bread, the four key areas of expertise are the ratio of bread to malt, the unique mashing regime, the lautering and filtration process without a grain bed and the secondary fermentation. Read on to learn more and expand your knowledge to become a bread-beer brewing expert.

TIP 1

The recipe provided works with a 50:50 malt to bread. If you would like to experiment with different ratios use the conversion factor provided to calculate the mass of malt to substitute with bread.

Conversion factor: 1.46
To calculate bread required in recipe:
Mass of Malt to substitute =
Total Malt in original recipe (g) x Fraction to replace (i.e., 0.5 for 50%)
Mass of Bread (g) =
Mass of Malt to substitute (g) x 1.46
Example for 40% substitution:
Mass of Malt to substitute = 2600g Malt x 0.4 = 1040 g
Mass of Bread = 1040 x 1.46 =
1518 g Bread for a 40% substitution

TIP 2

In step mashing, the mash temperature increases through a series of rests (time at a particular temperature). 45°C is termed the acid rest. At this temperature, the enzyme phytase breaks down a molecule called phytin and releases phytin acid which lowers the mash pH. 60°C is termed the protein rest. Here, two enzymes (proteinase and peptidase) break down long chained proteins, into medium and short chains and break them down to their component form. 70° is termed the saccharification rest. This rest is required in all mash programs. Here, two enzymes (alpha-amylase and beta-amylase) convert starch to fermentable sugars.

TIP 3

In traditional brewing a lautering step is used to separate the sweet wort from the grain by recycling the mash through a slotted base plate. Eventually a bed of grain forms on the base plate which acts a sieve to trap and retain smaller portions of the grain. Once the grain bed has formed the mash water can drain through it. The grain bed is then rinsed with fresh water to recover as many fermentable sugars from it as possible. In the case of beer brewed from bread, there is not enough grain present to form a grain bed. Commercial brewers using bread have been known to add husks from other grains to create a grain bed.

TIP 4

Secondary fermentation is carried out in the final bottle by homebrewers to add carbonation (fizz) to the finished beer. When the filtered beer is added into the final bottle a few yeast cells usually remain. If sugar is then added to the bottle immediately prior to it being capped the yeast present metabolises the sugar into ethanol and CO_2 (carbon dioxide). It is the CO_2 that provides the bubbles (carbonation) when the beer is opened. Different beer styles have various levels of carbonation. Some examples are:
Peroni: low to medium rising bubbles
Budweiser: medium to fast-rising bubbles
The rule of thumb is to add around 2g sugar per litre of beer. This can be more accurately calculated using online brewing calculators like https://www.brewersfriend.com/